**South Dakota Agricultural Education (AFNR)**

**Academic Integration Activities**

**ACTIVITY #9**

*Fundamental Ag Structures Technology students will be able to apply the properties of triangles and quadrilaterals to find unknown parts of wall, joist, and rafter designs.*

**1. Ag Standard**

Fundamental Ag Structures Technology 4.1: Assemble components of a structure.

* Construct a wall.
* Construct a floor joist.
* Erect a rafter.

**2. Academic Standard**

9-12.G.1.1: Students are able to apply the properties of triangles and quadrilaterals to find unknown parts (Application).

**3. Background Information**

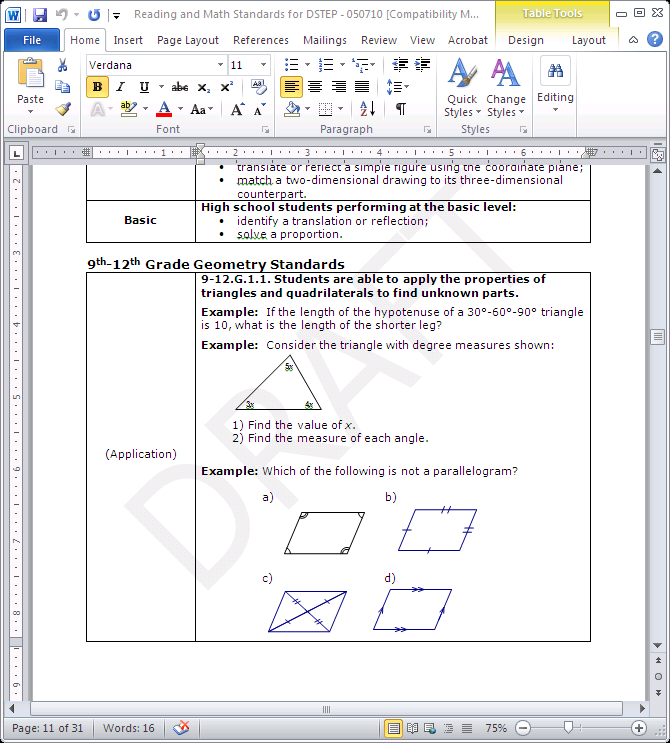
**Triangles** have a number of properties that apply to all types of triangles. A few of them are:

* The sum of all angles in a triangle is always 180 degrees.
* There can be, at most, only one right or obtuse angle in a triangle.
* An equilateral triangle (all sides the same length) is always equiangular (all angles the same degrees), thus an equiangular triangle is always equilateral.
* Every angle in an equilateral triangle measures 60 degrees.
* If two angles in a triangle are the same degree, the opposite sides are the same length.
* If two sides in a triangle are congruent, the opposite angles are also congruent

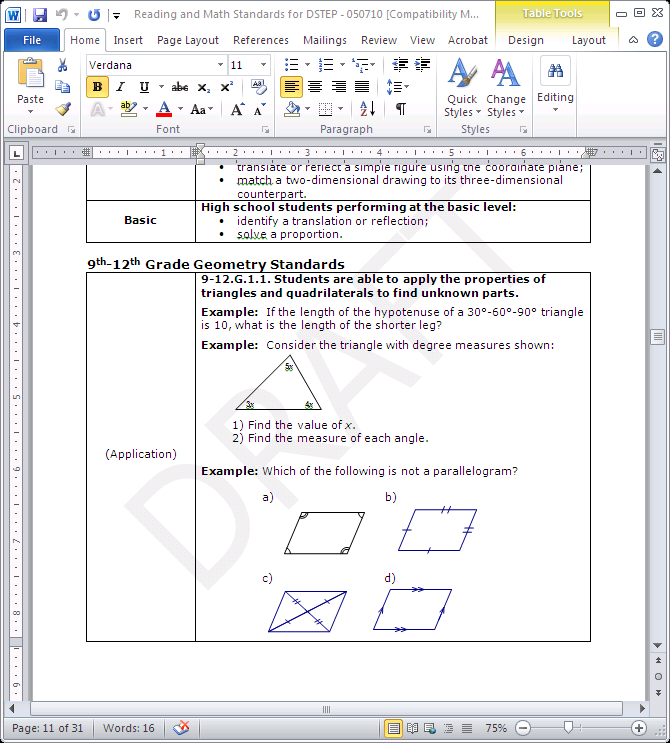
**Quadrilaterals** are any four sided shape. They too, have properties that apply to all quadrilaterals. They are:

* Must have four sides (or edges).
* Must have four vertices (or corners).
* The interior angles always add up to 360 degrees.

Common signs used on triangles and quadrilaterals

Represents same length: any similar or matching hash marks through a line means they are the same length

Represents the same angle: any similar or matching marks in the

angles of a quadrilateral or triangle means they are the same degree of angle.

**4. Example In Context**

Assume a student is prefabricating a wall. Prior to sheathing the wall panel she measures diagonally from corner to corner to check if the panel is square. She leaves this sketch for her partner to figure out. Is the wall square? Why or why not?

Looking at the marking of the drawings we know the lines with the 2 hash marks are the same length and that the lines with 1 hash mark are the same length. However, the 2 hash and the 1 hash lines are not the same length (or else they would be the same marking as well). Having different lengths of the diagonal measurements would mean that the panel is not square and would need to be adjusted prior to sheathing.

**5. Guided Practice Exercises**

Assume a student is working with an engineering program to design trusses for a loafing shed. The formula the program gives the student for the trusses is diagramed below. Find the value of x and then find the measure of each angle.

5x

**4x 3x**

Looking at the truss design above, we can rule out a few properties of triangles. It is not equilateral because it does not have any marks showing us so and the angles are all different. The rule that we do know which applies is that all angles must add up to 180 degrees. So we need to set up an algebraic equation to solve for x.

3x + 4x + 5x = 180⁰

So 12x = 180

Next divide both sides by 12 to get x alone: 12 x = 180

12 12

To get: x = 15

Now figure out all the angles by plugging 15 in for x.

5(15) = 75

3(15) = 45

4(15) = 60

Check the answers by adding them all up to make sure they equal exactly 180 degrees.

75 + 45 + 60 = 180

**6. Independent Practice Exercises**

Assume a student was laying floor joists on pre-marked 16 inch centers, made by another student in the class. When he looked back at his work he began to realize that something did not look right. The only tool he had was a speed square and used it to roughly figure the angles of each corner between the two joists that seemed to not be parallel. Below is the sketch he made. He forgot to mark one of the angles. Find the unknown angle.

83⁰

90⁰ 90⁰

*Answer: 97⁰ (the angles in a quadrilateral must add up to 360⁰, 90+90+83= 263, 360-263=97)*

Assume a student is designing a rafter system based on the drawing below. Fill in the unknown angles.

C D

B A 30⁰

*Answer: A = 90⁰, B = 30⁰, C = 60⁰, D = 60⁰ (based on properties of similar angles and all triangles add to 180⁰ these angles can be figured out)*

**7. Notes**

A Fundamental Ag Structures Technology teacher could incorporate trigonometry principles to calculate more complex problems in wall construction, floor joist layout, and rafter design to further students’ ability to find unknown parts of quadrilaterals and triangles.